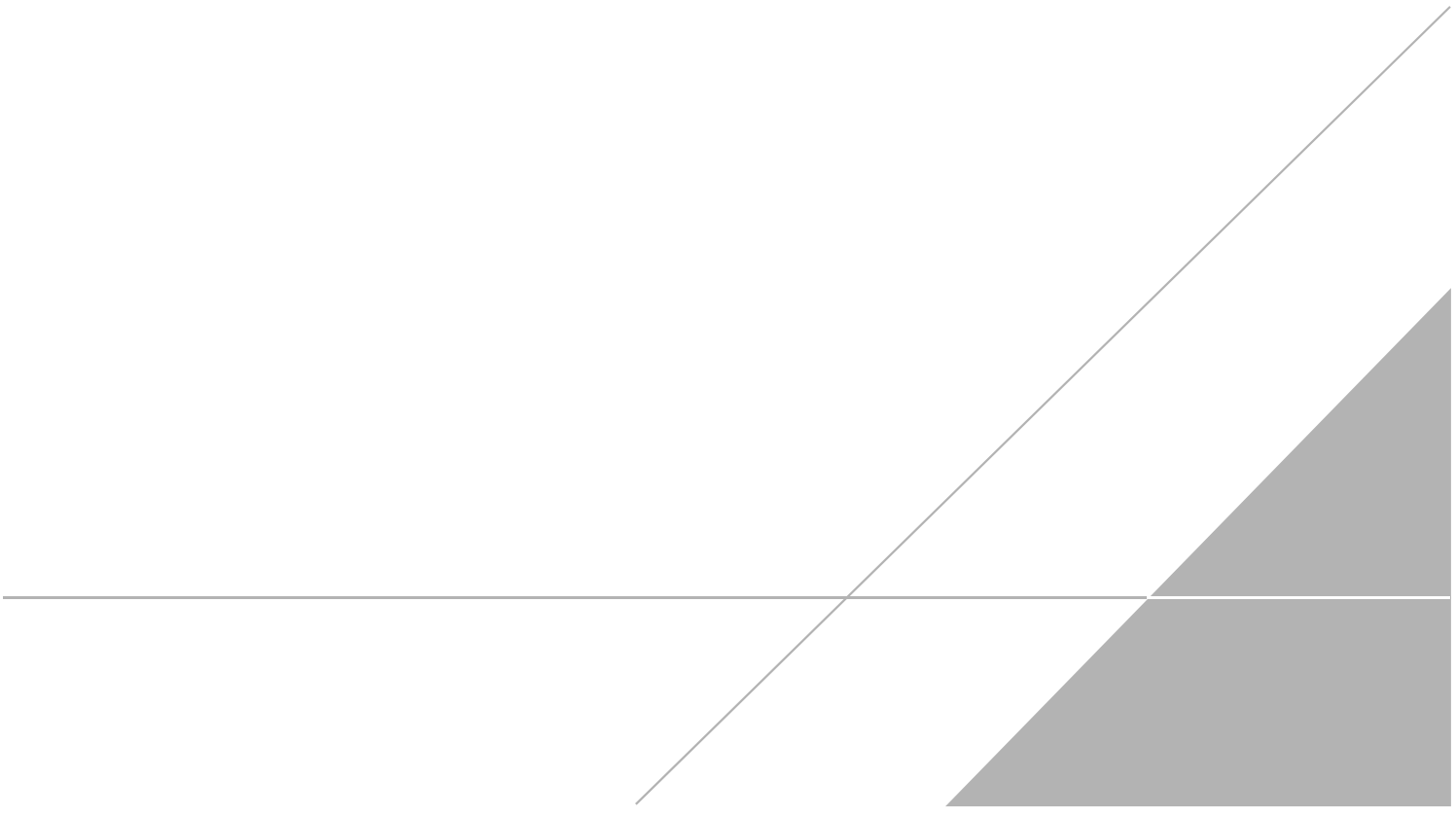
APPENDIX A

PCL Calculation Supporting Documentation



TCEQ APPROVAL LETTERS

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 21, 2017

Mr. Carlos Duarte
Environmental Engineer
Military Munitions and Environmental
Restoration Section – RPEC
U.S. Army Corps of Engineers
819 Taylor Street, Suite 3A12
Fort Worth, TX 76102-6124

Re: Approval
Proposed Bioavailability Inputs, Protective Concentration Levels, and Final Bioavailability Report (Report) for the former Foster Air Force Base, Skeet Range, Victoria Texas, dated October 18, 2017
Formerly Used Defense Site Project No. K06TX0601-05; TCEQ Facility ID No. T-1624
Customer No. CN600918916; Regulated Entity No. RN104662929

Dear Mr. Duarte:

The Texas Commission on Environmental Quality (TCEQ) has reviewed the above referenced submittal, received on October 19, 2017. The Report documents the results of the Bioavailability Study for polycyclic aromatic hydrocarbons (PAHs) in clay target fragments from soil at the Former Air Force Base (FAFB) Skeet Range Site. The Report summarizes activities completed as part of the Pilot Study and Main Study for evaluating the bioavailability of PAHs in soil from weathered clay target fragments by incidental ingestion and dermal exposure pathways. The goal of the investigation was to collect data for the development of site-specific relative bioavailability factors (RBAFs) for use in calculation of Tier 2 protective concentration levels (PCLs) for PAHs under the Texas Risk Reduction Program (TRRP: 30 TAC §350.74(j)(1)(C) and site-specific dermal absorption factors (ABS.ds) for PAHs in soil under TRRP (30 TAC §350.74(j)(1)(B)). The Report, which is the final version of the results of the Bioavailability Study, incorporates previous stakeholder comments and associate responses, including responses to comments (May 22, 2017) received from the USEPA Office of Superfund Remediation and Technology Innovation's (OSTRI's) Technical Review Workgroup Bioavailability Committee (TRW BAC), as well as responses to comments received from TCEQ (dated September and October 4, 2017) and observations received from the TRW BAC (September 29, 2017).

Based on our review TCEQ approves of the specific RBAF and ABS.d values proposed as inputs for site-specific Tier 2 PCLs which will be incorporated into the revised remedial investigation (RI) report for the Skeet Range.

Please be aware that it is the continuing obligation of persons associated with a site to ensure that municipal hazardous waste and industrial solid waste are managed in a manner which does not cause the discharge or imminent threat of discharge of waste into or adjacent to waters in the state, a nuisance, or the endangerment of the public health and welfare as required by 30 TAC §335.4. If the activities described in the report fail to comply with these requirements, please take any necessary and authorized action to correct such conditions. A

TCEQ field inspector may conduct an inspection of the site to determine compliance with the report.

Questions concerning this letter should be directed to me at (512) 239-2332. When responding by mail, please submit one paper copy and one electronic copy (on USB or disc) of all correspondence and reports to the TCEQ Remediation Division at Mail Code MC-127. An additional copy should be submitted in electronic format to the local TCEQ Region Office. The information in the reference block should be included in all submittals.

Sincerely,

Allan Posnick

Allan Posnick, Project Manager
Team 1, VCP-CA Section
Remediation Division
Texas Commission on Environmental Quality

AP/bk

cc: Mr. Brian Magee, Ph.D., Project Toxicologist, Arcadis U.S., Inc. 1 Executive Drive Suite 303, Chelmsford, Mass. 01824

Mr. Matthew K. Lambert, M.Sc., Environmental Scientist, U.S. EPA, Office of Superfund Remediation and Technology Innovation, William Jefferson Clinton Building, 1200 Pennsylvania Avenue, N. W., Mail Code: 5204P, Washington, DC 20460

Mr. Joseph Haney, Toxicology Division, Mail Code MC-168

Ms. Michelle Phillips, Waste Section Manager, TCEQ Region 14 Office, Corpus Christi

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 10, 2017

Mr. Carlos Duarte
Environmental Engineer
Military Munitions and Environmental
Restoration Section
U.S. Army Corps of Engineers
819 Taylor Street, Suite 3A12
Fort Worth, Texas 76102

Re: Approval of *Final PAH Bioavailability Pilot Study Report*, dated October 11, 2017
Former Shotgun Range Site
Former Laredo Air Force Base, Laredo (Webb County), Texas;
Formerly Used Defense (FUDs) Project No. K06TX0213, TCEQ Facility ID No. T1612
Customer No CN600918916; Regulated Entity No. RN104642863

Dear Mr. Duarte:

The Texas Commission on Environmental Quality (TCEQ) has received the above referenced report documenting the completion of a site-specific bioavailability study for polycyclic aromatic hydrocarbons (PAHs) in clay target fragments from soil at the former Laredo Air Force Base (AFB) Shotgun Range (SGR) Site from representatives of the US Army Corps of Engineers (USACE). Site-specific dermal absorption fractions (ABS.d) and relative bioavailability factors (RBAFs) were developed for PAH chemicals of concern (COCs) in response to 30 Texas Administrative Code (TAC) §350.74(j)(1)(B) and (C), respectively, for residential soil at the site. The TCEQ previously approved the final PAH Bioavailability Pilot Study Work Plan (dated November 20, 2014) for the former Laredo AFB SGR Site via email correspondence to representatives of the US Army Corps of Engineers (USACE) on January 14, 2015. The October 11, 2017 report also incorporates comment responses specific to the Laredo AFB SGR issued by the TCEQ in a letter issued June 6, 2017, and email directives dated September 29, 2017, and October 4, 2017, and comment responses by the U.S. Environmental Protection Agency's OSRI Technical Review Workgroup Bioavailability Committee (TRW BAC) in correspondence dated May 22 and September 29, 2017.

The cover letter conveying the October 11, 2017 report also provides proposed, site-specific Tier 2 Protective Concentration Levels (PCLs) for PAHs based on the site-specific ABS.d and RBAFs for soil developed in the study. The TCEQ previously reviewed the methodology supporting the calculation of the proposed Tier 2 PCLs for the former Laredo AFB SGR in a letter issued April 6, 2017.

Based on our review, the October 11, 2017 *Final PAH Bioavailability Pilot Study Report* and proposed, site-specific Tier 2 PCLs intended for evaluating residential soil at the former Laredo AFB SGR Site are hereby approved. The TCEQ understands the *Remedial Investigation (RI) Report* for the SGR Site is anticipated to be presented to the TCEQ in early 2018 and that a public meeting is planned after our review of the RI Report.

Questions concerning this letter should be directed to me at (512) 239-6542. When responding by mail, please submit one paper copy and one electronic copy (on USB or disc) of all correspondence and reports to the TCEQ Remediation Division at Mail Code MC-127. An additional copy should be submitted in electronic format to the local TCEQ Region Office. The information in the reference block should be included in all submittals.

Sincerely,

Eleanor T. Wehner

Eleanor T. Wehner, P.G.
Sr. Project Manager
VCP-CA Section
Remediation Division
Texas Commission on Environmental Quality

ETW/ew

cc: Mr. Alex Walter P.G., Principal Geologist, Arcadis U.S., Inc., 8725 Rosehill, Suite 350, Lenexa, Kansas 66215

Mr. Matthew K. Lambert, M.Sc., Environmental Scientist, U.S Environmental Protection Agency, Office of Land and Emergency Management, Office of Superfund Remediation and Technology Innovation, William Jefferson Clinton Building, 1200 Pennsylvania Avenue, N. W., Mail Code: 5204P, Washington, DC 20460

Mr. Joseph Haney, Toxicology Division, Mail Code MC-168

Mr. Arnaldo Lanese, Waste Section Manager, TCEQ Region 16 Office, Laredo

PCL CALCULATIONS

Tier 2 ^{GW}Soil PCL Calculation for Lead

Tier 2 PCL Development

As indicated in 30 TAC 350.75, the ^{GW}Soil PCL may be modified from the values provided in the Tier 1 tables to include site-specific assumptions. The estimation methodology defined by TRRP for the ^{GW}Soil PCL is indicated below.

Soil-to-Groundwater PCL Equation: ^{GW}Soil

$$^{GW}Soil = \frac{(Groundwater\ PCL) \cdot LDF}{K_{sw}}$$

where

$$K_{sw} = \frac{\rho_b}{\theta_{ws} + K_d \cdot \rho_b + H' \cdot \theta_{as}}$$

Model Parameter	Description
^{GW}Soil	Soil-to-groundwater PCL (mg/kg); constituent specific
Groundwater PCL	Critical groundwater PCL (mg/L); constituent specific
LDF	Lateral dilution factor (unitless); 10 (30 acre default)
Ksw	Soil-leachate partition factor (mg/L-water/mg/kg-soil)
ρ_b	Soil bulk density (g/cm^3); 1.67 (TRRP default)
θ_{ws}	Volumetric water content (cm^3 water/cm^3 soil); 0.16 (TRRP default)
K_d	Soil-water partition coefficient (cm^3 water/g soil); constituent specific based on pH
H'	Dimensionless Henry's Law Constant (unitless); constituent specific
θ_{as}	Volumetric air content (cm^3 air/cm^3 soil); 0.21 (TRRP default)

A pH-specific Tier 2 residential $^{GW}Soil_{class3}$ was determined for lead at the site. The soil pH at the site is 7.5. The default LDF for a 30 acre source area, along with the compound-specific Ksw (using default parameters and pH specific Kd from Figure 30 TAC §350.73(f)(1)(A) for loamy soils) and groundwater PCL were used to calculate the Tier 2 soil-to-class 3 groundwater PCL. The calculation is presented on the following page.

Appendix A. Residential pH Specific Tier 2 GWSOILclass3 PCL Calculation Summary for Lead
Former Laredo Air Force Base Shot Gun Range, Laredo (Webb County), Texas

Chemical of Concern	Tier 1 Res $^{GW}Soil_{class3}$ PCL	Tier 1 Res $^{GW}GW_{class3}$ PCL	Kd	Koc	foc	H'	pH	Calculated pH specific Residential Tier 2 PCL
Lead	150	1.5	597	NA	NA	0.00E+00	7.5	8,956

Notes:
All PCLs are presented in mg/kg for soil and mg/L for groundwater.
All PCLs are calculated based on 30 acre affected property.
Kd values for lead in loamy soils with pH of 7.5 obtained from Figure 30 TAC 350.73(f)(1)(A).
NA = Not applicable.

Tier 1 30-Acre Residential $^{Tot}Soil_{Comb}$ PCL Calculation for Benzo(j)fluoranthene

Appendix A. Tier 1 30 Acre Residential $^{Tot}Soil_{Comb}$ PCL Calculation for Benzo(j)fluoranthene
Former Laredo Air Force Base Shot Gun Range, Laredo (Webb County), Texas

		COC Specific Parameters			
CAS#	Constituent	H'	Dwat	Dair	Kd
205-82-3	Benzo-j-fluoranthene	0.000463	0.00000548	0.042	4198.459682

Inhalation RBEL

$$^{Air}RBEL_{Inh\text{-}noncarc}\ (mg/m^3) = \frac{RfC \times HQ \times AT.A.res \times 365\ days/yr}{EF.res \times ED.A.res}$$

$$^{Air}RBEL_{Inh\text{-}carc}\ (mg/m^3) = \frac{RL \times ATc \times 365\ days/yr}{URF \times 1000\ ug/mg \times EF.res \times ED.A.res}$$

$^{Air}RBEL_{Inh\text{-}noncarc}\ (mg/m^3)$ = 0.00E+00

$^{Air}RBEL_{Inh\text{-}carc}\ (mg/m^3)$ = 4.06E-04

$$^{Air}Soil_{Inh\text{-}VP} = \frac{^{Air}RBEL_{Inh}}{VF_{ss} + PEF}$$

$$VF_{ss}\left[\frac{mg/m^3 - air}{mg/kg - Soil}\right] = \frac{2\rho_b D_A}{(Q/C)\left[3.14 D_A \tau\right]^{\frac{1}{2}}} \cdot \left(\frac{10^4 cm^2}{m^2}\right)$$

$$D_A = \left[\frac{\theta_{as}^{3.33} D^{air} H' + \theta_{ws}^{3.33} D^{wat}}{\left[\theta_{ws} + K_d \rho_b + \theta_{as} H'\right]\theta_T^2}\right]$$

$$PEF\left[\frac{mg/m^3 - air}{mg/kg - soil}\right] = \frac{(0.036)(1-V)\left(\frac{U_m}{U_1}\right)^3 F(x)}{(Q/C)(3600 s/hr)}$$

$$VF_{ss}\left[\frac{mg/m^3 - air}{mg/kg - soil}\right] = \frac{\rho_b d_s}{(Q/C)\tau} \cdot \left(\frac{10^4 cm^2}{m^2}\right)$$

VF_{SS1}	D_A	VF_{SS2}	PEF	$^{Air}Soil_{Inh\text{-}VP\_noncarc}$	$^{Air}Soil_{Inh\text{-}VP\_carc}$
1.66757E-07	1.23537E-10	0.00013154	2.09492E-09	0.0	2401.8

Dermal RBEL

$$^{Soil}RBEL_{Derm\text{-}noncarc} = \frac{HQ \times RfDd \times BW.C \times AT.C.res \times 365\ days/yr}{10\text{-}6\ kg/mg \times ED.C.res \times EF.res \times SA.C.res \times AF.C.res \times ABS.d} = 0.00$$

$$^{Soil}RBEL_{Derm\text{-}c} = \frac{RL \times AT_c \times 365\ days/year}{SFd \times MF \times 10\text{-}6\ kg/mg \times EF.res \times DF.adj \times ABS.d} = 159.70$$

Ingestion RBEL

$$^{Soil}RBEL_{Ing\text{-}noncarc} = \frac{HQ \times BW.C \times RfD \times AT.C.res \times 365\ days/yr}{10\text{-}6\ kg/mg \times EF.res \times ED.C.res \times IRsoil.C.res \times RBAF} = 0.00$$

$$^{Soil}RBEL_{Ing\text{-}carc} = \frac{RL \times ATc \times 365\ days/yr}{SF \times MF \times 10\text{-}6\ kg/mg \times EF.res \times IRsoil.AgeAdj.res \times RBAF} = 60.83$$

Ingestion of Below Ground Vegetables RBEL

$$^{BgVeg}RBEL_{Ing\text{-}noncarc} = \frac{HQ \times BW.C \times RfD \times AT.C.res \times 365\ days/yr}{EF.res \times ED.C.res \times IRbg.C.res} = 0.00$$

$$^{BgVeg}RBEL_{Ing\text{-}carc} = \frac{RL \times ATc \times 365\ days/yr}{SF \times EF.res \times MF \times IRbg.AgeAdj.res} = 6.08$$

$$^{Veg}Soil_{Ing\text{-}Org} = \frac{\left(^{BgVeg}RBEL_{Ing}\right)\left(Ks_{Veg}\right)}{\left(RCF\right)\left(VG_{bg}\right)}$$

$^{Veg}Soil_{Ing\text{-}org\_noncarc}$	$^{Veg}Soil_{Ing\text{-}org\_carc}$
0.00	370.38

$^{Tot}Soil_{Comb}$ PCL

$$^{Tot}Soil_{Comb}\ PCL = \frac{1}{(^{Air}Soil_{Inh\text{-}VP})^{-1} + (^{Soil}Soil_{Derm})^{-1} + (^{Soil}Soil_{Ing})^{-1} + [(^{Veg}Soil_{Ing\text{-}Inorg}) \text{ or } (^{Veg}Soil_{Ing\text{-}org})]^{-1}}$$

$^{Tot}Soil_{Comb\_noncarc}$	$^{Tot}Soil_{Comb\_carc}$	Tier 1 $^{Tot}Soil_{Comb}$ PCL
NA	38.7	38.74

Tier 1 $^{Tot}Soil_{Comb}$ PCL is the minimum of the $^{Tot}Soil_{Comb\_noncarc}$ and $^{Tot}Soil_{Comb\_carc}$ PCLs

Parameters

0.37	θ_T	Total soil porosity
0.16	θ_{ws}	Volumetric water content of vadose zone soils (TRRP default)
0.21	θ_{as}	Volumetric air content of vadose zone soils (TRRP default)
1.67	ρ_b	Soil bulk density (g/cm^3)
40.76	Q/C	Inverse of mean concentration in air at the center of affected soil area (default for 30 acre)
305	d_s	Thickness of affected surficial soil (cm)
9.5E+08	τ	Exposure interval (TRRP default)
0.5	V	Fraction vegetative cover (unitless)
4.8	Um	Mean annual windspeed at 7m height (m/s)
11.32	Ut	Equivalent threshold value of windspeed at 7m height (m/s)
0.224	F(x)	Function dependent on (Ut/Um) derived using Cowherd et. Al (1985) (unitless)
0.13	ABSd	Dermal Absorption Fraction (unitless)
0.2	AF.C.res	Soil-to-Skin Adherence Factor (mg/cm^2-event) - Child
0.2	AF0<6	Age-Specific Adherence Factor (mg/cm^2-event)
0.1	AF6<18	Age-Specific Adherence Factor (mg/cm^2-event)
0.1	AF18<30	Age-Specific Adherence Factor (mg/cm^2-event)
70	ATc	Averaging Time - carcinogens (yr)
30	AT.A.res	Averaging Time - noncarcinogens (yr) - Adult
6	AT.C.res	Averaging Time - noncarcinogens (yr) - Child
15	BW.C	Body weight (kg) - Child
15	BW0<6	Age-Specific Body Weight (kg)
45	BW6<18	Age-Specific Body Weight (kg)
70	BW18<30	Age-Specific Body Weight (kg)
351.6	DF.adj	Dermal Adjustment Factor (mg-yr/kg-event)
30	ED.A.res	Exposure Duration (yr) - Adult
6	ED.C.res	Exposure Duration (yr) - Child
6	ED0<6	Age-Specific Exposure Duration (yr)
12	ED6<18	Age-Specific Exposure Duration (yr)
12	ED18<30	Age-Specific Exposure Duration (yr)
350	EF.res	Exposure Frequency (days/yr)
1	HQ	Hazard Quotient
120	IRsoil.AgeAdj.res	Age-Adjusted Soil Ingestion Rate (mg-yr/kg-day)
191	IRsoil.C.res	Soil Ingestion Rate (mg/day) - Child
2200	SA.C.res	Skin Surface Area (cm^2) - Child
2200	SA0<6	Age-Specific Skin Surface Area (cm^2)
3500	SA6<18	Age-Specific Skin Surface Area (cm^2)
4800	SA18<30	Age-Specific Skin Surface Area (cm^2)
0.0012	IRbg.AgeAdj.res	Below-Ground Vegetables Ingestion Rate (kg-day) - Age Adjusted
0.001	IRbg.C.res	Below-Ground Vegetables Ingestion Rate (kg-day) - Child
1	MF	Modifying Factor for SF (unitless)
1	RBAF	Relative Bioavailability Factor (unitless)
0.00001	RL	Acceptable Risk Level
4198	Ksveg	Soil-water partition coefficient (mL/g) = Koc x foc
6895.7	RCF	Ratio of concentration in roots to concentration in soil pore water (mg/kg) (µg/ml) = $(10^{((0.77 \times \log Kow)-1.52)}+0.82)/0.222$
0.010	VGbg	Below ground vegetable correction factor (unitless)
524807	koc	Soil organic carbon-water partition coefficient (cm^3-water/g-carbon)
0.008	foc	Fraction of organic carbon in soil (g-carbon/g-soil)
6.11	log Kow	Octanol-water partition coefficient

Toxicity Factors

	RFDo	Oral Reference Dose (mg/kg-day)
	RFC	Reference Concentration (mg/m^3)
0.1	SF	Slope Factor (mg/kg-day)$^{-1}$
0.00006	URF	Inhalation Unit Risk Factor (µg/m^3)$^{-1}$

Notes:

COC specific parameters were obtained from TRRP Tables (March 2017).